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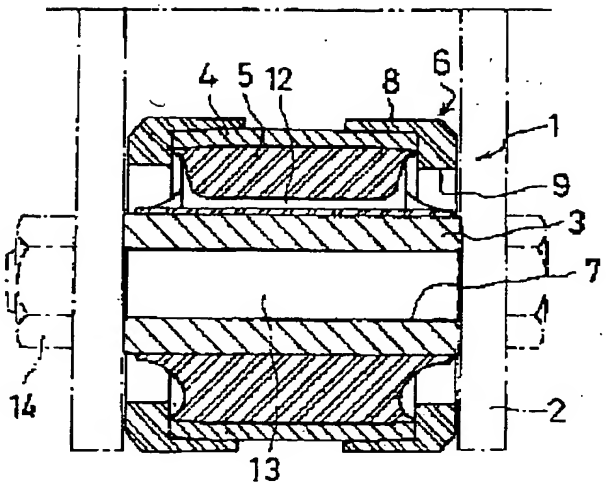
TITLE : RUBBER BUSH



ABSTRACT : PROBLEM TO BE SOLVED: To ensure effectiveness in the change of the axial characteristic of a bush and prevent rattling noises from being caused by contact between the bush and a vehicle bracket.

SOLUTION: A rubberlike ring 6 made of a single piece of rubber is fitted over the end of an outer cylinder 4 in such a way as to be separated from a bush main body including a rubberlike elastic body 5, thus enabling an axial spring constant to be changed readily. Further, the rubberlike ring 6 is constructed of a surface lubricating member, so that a lubricant oozing out to the surface of contact with a vehicle bracket reduces the frictional resistance to the bracket 2 and prevents rattling noises form being caused by a stick slip.

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[diagram]

(57) Abstract

Problem

To provide a bushing with readily adjustable axial characteristics and a capability of suppressing noise caused by friction against vehicle brackets

Means of solving the problem

By fitting rubber rings 6, each consisting of a single piece of rubber, on the end/s of external tube 4 separate from a bushing main body that includes rubber elastic member 5, [this invention] makes it possible to easily adjust the spring constant in the axial direction; and by means of reducing friction resistance against bracket 2 with a lubricant released from a surface lubricating element that constitutes said rubber ring 6, [this invention] prevents noise caused by the stick-slip phenomena.

Claims:

1. A rubber bushing comprising a bushing main body consisting of a cylindrical rubber elastic member provided around a shaft member, and rubber rings made separate from said rubber elastic member and provided at the axial ends of said bushing main body.

2. The rubber bushing described in claim 1 wherein said rubber rings are fitted on the outer ends of the bushing main body.

3. The rubber bushing described in either claim 1 or claim 2 wherein the ring hole of said rub ring is made larger than the diameter of said shaft member so that it fits loosely around said shaft member.

4. The rubber bushing described in claim 1, 2, or 3 wherein said rubber ring is made a surface lubricating element.

Detailed description of the invention

0001

Relevant technical field: This invention is a rubber bushing to be used in coupling elements of automobiles, such as suspension arms, and, in particular, pertains to a rubber bushing that is effective when the axial spring constant of the bushing is modified.

0002

Prior art: Because rubber bushings are used for elastically supporting various coupling elements of the suspension systems of automobiles, various styles have conventionally been offered to improve steering stability and riding comfort characteristics as well as to suppress noises and vibrations, and to provide a desirable spring constant.

0003

An example of a rubber bushing according to prior art, example 1, is shown in Fig. 3. Rubber bushing 100 shown here is equipped with an inner tube 101 that is inserted into the vehicle side bracket that serves as a metal shaft member, an outer tube 102 that is provided around the former and is press-fitted into a jointing tube (not shown) of the suspension arm, and a rubber elastic member 103 that exists between inner and outer tubes 101, 102 and are adhered to the inner and outer tubes by vulcanization.

0004

Fig. 4 shows a cross section of an example of a rubber bushing according to prior art, example 2. Bushing 105 here comprises an outer cylinder flange 106 formed at one end of outer tube 102, and a rubber stopper 107 glued on to said flange 106, wherein the axial displacement of the suspension arm is supported by said rubber stopper 107 contacting the vehicle bracket.

0005

Problems to be solved by the invention: In general, rubber bushings used in automobiles receive force from three axial directions: while the vehicle is in motion, not only in the axial direction, but also in the direction perpendicular to the axis, and twisting (the turning direction of the [illegible]). While rubber bush 100 shown in Fig. 3 receives forces from three axial directions in the same way, there are cases where it is desirable to increase the spring

constant in the axial direction without changing the spring constants in the direction perpendicular to the axis and in the twisting direction.

0006

Moreover, although a rubber bushing 105 is proposed as shown in prior art example 2 of Fig. 4 as a means of increasing the spring stiffness in the axial direction, it presents a

problem in that rubber bushing 105 is not only different in style from the rubber bushing shown in Fig. 3, but also causes displacements not only in the axial direction but also in the direction perpendicular to the axis and in the twisting direction when the automobile is in motion, thus causing noises due to the stick-slip phenomenon when the vehicle's metal bracket rubs against rubber stopper 107 that is in contact with the bracket.

0007

In light of the above, the first aim of the present invention is to provide a rubber bushing which is effective in modifying the spring constant in the axial direction without modifying the shape of the rubber bush; its second aim is to provide a rubber bushing for suppressing the noise caused by stick-slips.

0008

Means of solving the problem: The present inventors, to achieve the above aims, used a construction in which rubber ring(s), which are independent of the rubber elastic member, are provided on the end(s) (either one end or both ends) of the rubber elastic member in order to be able to adjust the axial spring constant. The rubber ring used is made of a rubber composite material that is generally used as avibration damping rubber, such as natural rubber, synthetic rubber, urethane elastomer and the like, and formed into a ring shape; its axial thickness and rubber hardness are chosen to obtain the desired spring constant in the axial direction of the rubber bushing.

0009

For the placement of the rubber ring, because the rubber ring is to be placed between the bushing main body and the vehicle bracket, it is preferable for it to be positioned properly in order to maintain a desired spring characteristic. As a means of positioning, the method of forming an engaging part on the outer periphery of the rubber ring as an integral part and assembling it by fitting the engagement part on the outer periphery of the bushing main body is better than the method of adhering the rubber ring to the rubber elastic member side, as it will make the assembly work simpler, and generate no gap between [the ring] and the side of the bushing main body when the rubber bushing deforms in the axial direction, thus providing smooth operating characteristic.

0010

Accordingly, because this invention is to make it possible to adjust the axial spring constant of the bushing by means of providing rubber ring(s) in the axial end(s) of the bushing main body, the invention can be applied to any type of bushing main body as long as it has at least a rubber elastic member on the periphery of the shaft member; in other words, it can be applied to a rubber bushing formed in such a way, or a rubber bushing having a thin-walled outer tube on the outer periphery of the rub elastic member. The rubber ring can be fitted on such a rubber bushing either at the end of the rubber elastic member or the outer tube.

0011

The engaging part for fitting on the outer periphery of the bushing main body can be formed as desired as long as it extends from the outer periphery of the ring toward the main body side; for example, a cylindrical shape that corresponds to the external shape of the outer tube or the rubber elastic member, or a plurality of hook-like objects that are

spaced along the periphery of the ring. However, a cylindrical shape design is preferable as it provides closer contact with the bushing main body. The engaging part can be made of rubber, plastic, or metal, but it is preferable to use the same material as the one used for the ring from the standpoint of tease of forming. The axial length of the engaging part should preferably be set to a length that does not interfere with the suspension arm that is to be connected with the rubber bushing in order to be able to adjust only the spring stiffness in the axial direction.

0012

The hole size of the rub ring can be either equal to the outer diameter of the shaft element of the shaft material, or larger than the outer diameter of the shaft element so that it can loosely fit to the shaft element. It is preferable to use a ring hole larger than the diameter of the shaft element as it would not affect the spring constant in the prying direction (the direction of swiveling within the plane containing the axis).

0013

Moreover, since the rubber ring is formed independently of the rubber elastic member of the bushing main body, it is possible to use a surface lubricating element as the rubber ring in order to prevent the occurrence of stick-slip phenomena arising from contact with vehicle brackets. If a stopper rubber adhered to the outer tube flange by vulcanization is added with a lubricant to make it a surface lubricating element as shown in prior art example 2 of Fig. 4, then there is the problem that the adhesion force with the foreign material is reduced by the lubricant synthesis. However, because the rubber ring is independent of the rubber elastic member it does not affect the rubber elastic member on the main body side, and because only the rubber ring is a surface lubricating member, the occurrence of stick-slips is prevented.

0014

The method of making the rubber ring a surface lubricating member can be achieved by mixing a lubricant in the rubber compound of the rubber ring, or by applying a coating layer with a low friction coefficient on the surface of the rubber ring. When these means are implemented, the friction resistance decreases and can prevent the occurrence of noises due to stick-slips.

0015

In case of a rubber compound containing a lubricant, the lubricant will come to the rubber surface so that the strength of jointing with a different material such as metal becomes a problem. Therefore, the rubber ring is preferably made of a single piece of rubber blended with a lubricant, as such a configuration can eliminate the problem of adhesion peeling from different materials and can provide a rubber bushing with an excellent durability

0016

As a lubricant, fatty acid amide, aliphatic hydrocarbon, higher aliphatic alcohol, higher fatty acid group, metallic soap group, and fatty acid ester group lubricants, as well as their compounds, or even silicon oil can be used.

0017

On the other hand, a fluoride coating layer, silicon coating layer, and other layers of resins such as polytetrafluoroethylene (PTFE) and polyethylene can be used as the coating layer to be applied on the

surface of the ring in order to provide surface lubrication. A rubber ring coated with such a coated layer has the advantage that, in comparison with the above-mentioned combination of lubricants, it does not necessary have to be formed from a single rubber body and, therefore, can also be formed of a coating layer on the surface of a rubber ring consisting of a rubber piece adhered to a metal ring by vulcanization.

0018

As shaft elements, both hollow tubes and solid members can be used and the length can be any length as long as it can provide a space to have the ring section of the rubber ring between the end of the outer periphery of the bushing main body and the vehicle bracket. Also, the rubber elastic member that constitutes the rubber bushing can be of various shapes including those that have a specific hole for a special purpose or an intermediate tube.

0019

Embodiments: Some preferred embodiments will be described below referencing the accompanying drawings. Fig. 1 is a diagram showing the disassembled state of a rubber bushing of the first embodiment of the invention, and Fig. 2 is a cross section drawing showing how it is mounted on a vehicle's bracket.

0020

Rubber bushing 1 in this embodiment has a metal inner tube 3, which is mounted on bracket 2 of the vehicle and serves as a shaft member, an outer tube 4 arranged around it, a rubber elastic member 5 placed between inner and outer tubes 3 and 4 and adhered to them, and a rubber ring 6 made of a single piece of rubber fitted on each end of outer tube 4.

0021

Inner tube 3 is a thick-walled cylindrical pipe, the outer periphery of its middle section serves as an area to which rubber elastic member 3 is affixed; both ends of it are places where rubber rings 6 are loosely affixed; and its center hole 7 is a hole through which bolt 13 that connects with bracket 2 of the vehicle side passes through. Outer tube 4 consists of a thin-walled cylindrical member, on the outer periphery of which a connection tube such as a suspension arm is affixed.

0022

Rubber elastic body 5 is a cylindrical piece placed between inner and outer tubes 3 and 4, and is adhered to inner and outer tubes 3 and 4 by vulcanization; hole 12 is formed through one part. The material of this rubber elastic member can be any of those materials that are generally used as vibration prevention rubber; e.g., synthetic rubber, SBR (styrene butadiene rubber), BR (butadiene rubber), IR (isoprene rubber), NBR (acryl nitrile butadiene rubber), CR (chloroprene rubber), IIR (butyl rubber), EPDM (ethylene propylene rubber), and urethane elastomer. Specific elasticity, mechanical strength, dynamic characteristic, fatigue characteristic, etc., are obtained by adding blending agents such as vulcanizing agents, vulcanizing promotion agents, aging preventive agents, reinforcing agents, filling agents, softening agents, etc. to the raw material rubber.

0023

Rubber ring 6 is formed separately from said rubber elastic member 5 by adding various blending agents and vulcanizing and is a single piece of rubber that is adhered neither to inner and outer tubes 3, 4 nor to

any metal rings. A cylindrical part 8 that serves as an engaging part to engage with and position itself against outer tube 4 to forms the hole into a cup shape. The inner diameter of cylindrical part 8 is chosen to be the same dimension as the end outer shape of outer tube 4, and it is fitted onto outer tube 4 in the position where the inner end surface of ring part 6a abuts the end surface of outer tube 4. The axial length of cylindrical part 8 is chosen in such a way as not to interfere with the connecting tube of the suspension arm.

0024

A ring hole 9 that has a diameter larger than the outer diameter of inner tube 3 is formed in the center of ring part 6a of rubber ring 6. Ring hole 9 does not interfere with inner tube 3, so that it does not affect the prying spring characteristic of the bushing. The thickness of ring part 6a of rubber ring 6 can be any shape convenient for operating conditions as long as it can absorb the axial displacement of the suspension arm. If the thickness of rubber ring 6 is chosen in such a way as to leave no gap between it and vehicle bracket 2 as it is fitted on outer tube 4, a desired spring characteristic can be achieved from the initial stage of usage in axial displacements.

0025

The rubber composition of rubber ring 6 is chosen in such a way as to be able to function as a surface lubricating member by blending the lubricant into the raw material rubber. An example of the rubber composition is as follows:

0026

(1) Natural rubber	100	(weight parts)
(2) Zinc oxide	5	
(3) Stearic acid	1	
(4) Sulfur	2	
(5) Vulcanizing promotion agent (CBS)	1	
(6) Carbon black (HAF)	50	
(7) Paraffin wax (melting point 140°F)	10	

(Note) CBS: N-Cyclohexyl-2-benzothiazolelsulfenamide

HAF: High abrasion furnace

0027

The blending ratio of the lubricant is 10 weight parts in the above example and any ratio can be used as long as it is capable of preventing the generation of noise, but, specifically, it is preferable for it to be 1 - 20 weight parts.

0028

Rubber ring 6 is fitted on both ends of outer tube 4 after the main body of rubber bushing 1 is formed by adhering rubber elastic member 5 between inner and outer tubes 3 and 4, mounting inner tube 3 after

inserting bolt 13 through it, and fastening it with nut 14 . The rubber for rubber ring 6 can be of a hardness different from that of the rubber for rubber elastic member 5, so that it is possible to change (increase) the stiffness in the axial direction of the bushing.

0029

Also, since the rubber ring is positioned relative to the outer tube of the bushing by means of cylindrical part 8, no gap will be generated between it and the outer tube edge, thus assuring a smooth spring characteristic. Also, ring hole 9 of the rubber ring is formed larger than the diameter of inner tube 3, so that it does not interfere with inner tube 3 and does not affect the prying spring characteristic.

0030

Moreover, rubber ring 6 absorbs the axial displacement of the suspension arm and causes almost no noise due to stick-slips as the friction resistance between rubber ring 6 and vehicle bracket 2 is alleviated because of the lubricant released from rubber ring 6 as a sliding phenomenon occurs between them when a stress in the direction perpendicular to the axis or the twisting direction is applied.

0031

Effect of the invention: As can be seen from the above, this invention makes it possible to change the spring constant only in the axial direction without changing the spring constants in the direction perpendicular to the shaft and the twisting direction, as the rubber rings, which are independent of the rubber elastic member, are provided on both ends of the bushing main body. Moreover, it also provides an effect of preventing noise that occurs due to stick-slips on the contact surface between the bushing and the vehicle bracket because the rubber rings are made a surface lubricating element.

Brief description of the drawings:

Fig. 1 Front view of the rubber bushing representing an embodiment of the invention

Fig. 2 Cross section showing its mounting on a vehicle bracket

Fig. 3 Cross section of an example of a rubber bushing according to prior art example 1

Fig. 4 Cross section of an example of a rubber bushing with a stopper rubber according to prior art example 2

List of labels used in the drawings:

1 Rubber bushing

2 Vehicle bracket

3 Inner tube

4 Outer tube

5 Rubber elastic member

6 Rubber ring

7 Center hole

8 Cylindrical part

9 Ring hole